

PATENT CLAIMS

1           1. A method of selectively detecting and/or quantifying  
2 super paramagnetic and/or ferro magnetic particles, characterized in  
3 that based upon the nonlinearity of the magnetization  
4 characteristics of the particles, frequency components of magnetic  
5 fields generated by their magnetization are measured in terms of  
6 mixed frequencies.

1           2. The method according to claim 1, characterized in that  
2 the particles, for modulating their magnetization characteristics  
3 (5) , are subjected to a modulating magnetic field (4, 18) of  
4 predetermined frequency.

1           3. The method according to one of the preceding claims in  
2 which the modulating magnetic field (4, 18) has a frequency between  
3 50 and 100 hertz.

1           4. The method according to one of the preceding claims  
2 characterized in that the particles are subjected to a scanning  
3 magnetic field (15) with a frequency different from the modulating  
4 magnetic field (4, 18).

1           5. The method according to one of the preceding claims in  
2 which the scanning magnetic field (15) has a frequency between 10  
3 and 100 kilo hertz.

1           6. The method according to one of the preceding claims  
2 characterized in that a response magnetic field (19) of the particle  
3 induced by the effect of the two alternating magnetic fields (15,  
4 18) thereon is measured.

1           7. The method according to one of the preceding claims,  
2 characterized in that the amplitude variation (8, 11) of the  
3 response magnetic field (19) is measured at the frequency of the  
4 scanning magnetic field (15).

1           8. The method according to one of the preceding claims in  
2 which the frequency components of the amplitude variation (8, 11) of  
3 the response magnetic field (19) at the frequency of the scanning  
4 magnetic field (15) are measured as whole number multiple of the  
5 frequency of the modulating magnetic field (4, 18).

1           9. The method according to one of the preceding claims in  
2 which the frequency components of the amplitude variation (8, 11) of  
3 the response magnetic field (19) to the  
4 frequency of the scanning magnetic field (15) are measured for the  
5 even number multiple of the frequency of the modulating magnetic  
6 field (4, 18).

1           10. The method according to one of the preceding claims  
2 in which the frequency components of the amplitude variation (8, 11)  
3 of the response magnetic field (19) to the  
4 frequency of the scanning magnetic field (15) is measured, for the  
5 signal which is twice the frequency of the modulating magnetic field  
6 (4, 18).

1           11. The method according to one of the preceding claims  
2 characterized in that the amplitude variation (11) of the response  
3 magnetic field (19) is converted and as an output voltage (24) is  
4 used to determine the concentration of the analyte.

1           12. A device for the selective detection and/or  
2 quantification of super power magnetic and/or thermal magnetic  
3 particles with analytes, comprising:  
4           a vessel (12) with an analyte to be detected or to be  
5 quantified,  
6           at least one oscillator (13, 16; 25) for producing  
7 frequencies of alternating magnetic fields (15, 18),  
8           at least one field generator (14, 17) for subjecting  
9 the analyte to alternating magnetic field (15, 18),  
10           a magnetic field sensor (20) for measuring a response  
11 magnetic field (19) of the particles, and  
12           at least one phase sensitive detector (21, 23).

1           13. The device according to claim 12 comprising at least  
2 one frequency dividers (26, 27, 28, 29, 30) for dividing the  
3 frequency of the oscillator (25).

1           14. The device according to claim 13 characterized in  
2 that the frequency divider or frequency dividers (26, 27, 28, 29,  
3 30) divide the oscillator frequency in proportions of whole positive  
4 numbers.

1           15. The device according to claim 13 or 14,  
2 characterized in that the frequency dividers (26, 27, 28) divide the  
3 oscillator frequency into the ratios

4            $\frac{1}{\ell},$

5            $\frac{1}{m \cdot n}$

6            $\frac{1}{n}$

1           16. The device according to one of claims 13 through 15  
2 characterized in that the frequency dividers (28, 29, 30) divide the  
3 oscillator frequency in the ratios of

$$\frac{1}{n}$$

$$\frac{1}{n+m}$$

$$\frac{1}{n(n+m)}$$

1           17. The device according to one of the preceding claims  
2 15 or 16 with whole positive numbers for  $l$ ,  $m$ ,  $n$ .

1           18. The device according to one of the preceding claims  
2 15 - 17 with  $m$  as an even number, especially with  $m=2$ .

1           19. The device according to one of the preceding claims  
2 13 - 18 with at least one frequency divider (26, 28) dividing the  
3 oscillator frequency into a reference frequency which is stored in  
4 at least one phase sensitive detector (21, 23).

1           20. The device according to one of the preceding claims  
2 13 - 19 in which a frequency from one frequency divider (26) of the  
3 oscillator frequency is stored as a reference in one phase sensitive  
4 detector (21) and a frequency from another frequency divider (28)  
5 dividing the oscillator frequency is stored as a reference in  
6 another phase sensitive detector (23).

1           21. The device according to one of the preceding claims  
2 13 - 20, characterized in that field generators (14, 17) are  
3 provided which are controlled by the frequencies of the frequency  
4 dividers (26, 27; 29, 30).

1           22. The device according to one of the preceding claims  
2 12 - 21 comprising at least one frequency multiplier (22).

1           23. The device according to one of the preceding claims  
2 12 - 22, characterized in that the magnetic field sensor (20) is  
3 configured as a differential field sensor.

1           24. The device according to one of the preceding claims  
2 12 - 23, characterized in that the magnetic field sensor (20)  
3 comprises two partial coils of the same construction type.

1           25. The device according to one of the preceding claims  
2 12 - 24, characterized in that the partial coils of the magnetic  
3 field sensor (20) are wound in opposite sensors.

1           26. The device according to one of the preceding claims  
2 12 - 25 characterized in that the partial coils of the magnetic  
3 field sensor (20) are connected in series.

1           27. The device according to one of the preceding claims  
2 12 - 26, characterized in that the container with the analyte is in  
3 contact with only one of the two partial coils of the magnetic field  
4 sensor (20).

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